



Surface Technology for the Agile Air Transportation System

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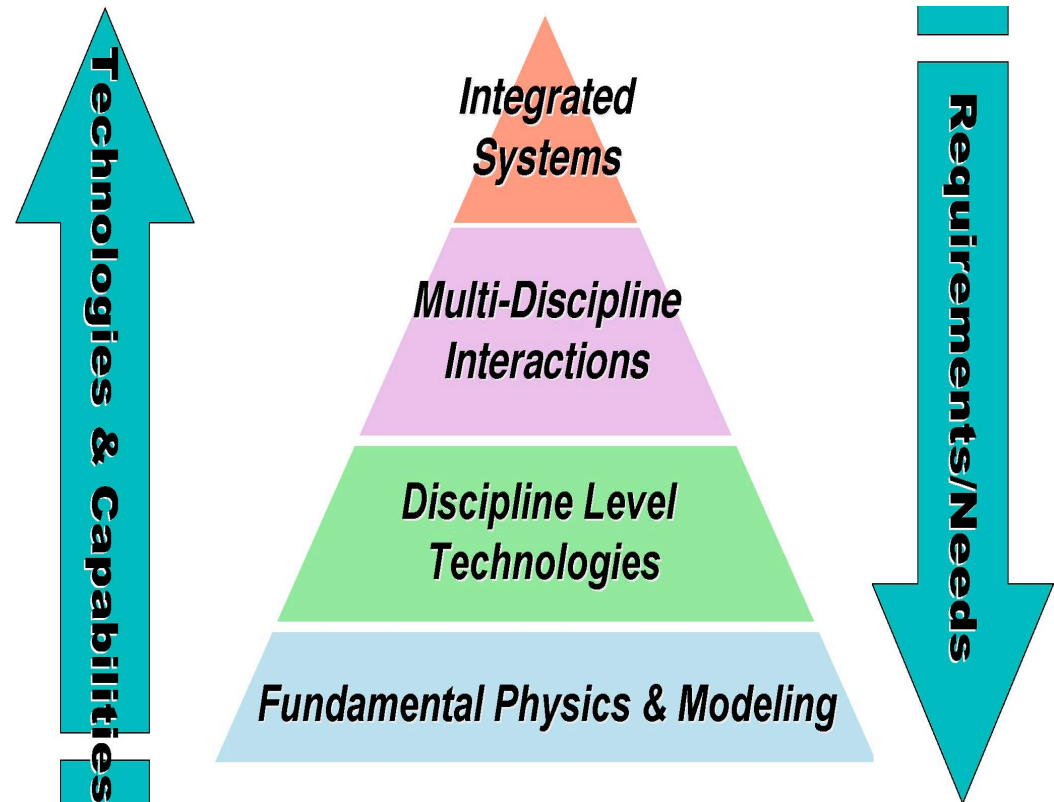
Outline

- **NASA Aeronautics research overview**
- **Airspace System Program (ASP) overview**
- **Next Generation Air Traffic System Air Traffic Management (NGATS ATM) - Airportal Project Research**
 - **Status**
 - **Problem statement**
 - **Candidate research areas**
 - **Expected Benefits**
 - **Partnerships**



NASA Aeronautics Research: Four-Level Approach

- ♣ **Level 1:** Conduct foundational research to further fundamental understanding of underlying physics and an ability to model that physics.
- ♣ **Level 2:** Leverage foundational research to develop technologies and analytical tools focused on discipline-based solutions relative to next generation airspace and airport issues.
- ♣ **Level 3:** Integrate multi-disciplinary methods and technologies to balance solutions across disciplines.
- ♣ **Level 4:** Build on results from Levels 1 - 3 to support development of high capacity, efficient, and safe airspace and airport systems that will enable NGATS as defined by Joint Planning and Development Office (JPDO).





Airspace Systems Program



Goal: To maximize operational throughput, predictability, efficiency, system agility, and access into airspace system while assuring safety, security and environmental protection

Projects

- ♣ NGATS ATM-Airspace Project**
- ♣ NGATS ATM-Airportal Project**



Airspace Systems Program

Project Research Thrusts

NGATS ATM-Airspace Project

- ♣ Dynamic airspace configuration
- ♣ Traffic flow management
- ♣ Separation assurance (sequential) for transition and cruise
- ♣ Separation assurance (simultaneous) for terminal airspace

NGATS ATM-Airportal Project

- ♣ Coordinated surface movement optimization
- ♣ Separation requirements and assurance for terminal area

- ♣ **NGATS ATM-Airportal Project will focus on research issues related to ground and terminal area domains, while NGATS ATM-Airspace Project will focus predominantly on en route airspace.**
- ♣ **Each project will leverage research in the other project.**
- ♣ **Each project will integrate its results with those of the other to ensure alignment of “block-to-block” solutions with NGATS needs.**



NGATS ATM-Airportal Project Status

- **NGATS ATM-Airportal Project is in a planning and development stage**
- **We will be mapping closely to the Joint Planning and Development Office (JPDO) NGATS goals for the surface and terminal area**
- **There are a number of candidate research areas that we expect to pursue in our project**
 - **These areas have not yet been finalized**



NGATS ATM- Airportal Project Problem Statement

- **Airportal surface environment represents a significant NAS constraint**
 - **Complexity and inflexible geographic constraints of the airport configuration (runways, taxiways, gates)**
 - **Mix of vehicles on the surface (aircraft, trucks, baggage carts)**
 - **Wake vortex and weather constraints**
 - **Multiple users with different goals and infrequent data sharing**



NGATS ATM- Airportal Project Problem Statement (2)

- **Joint Planning and Development Office (JPDO) estimates indicate a growth of the number of passengers from 2 million to 4 or 5 million per day**
- **Existing airportal design and technology will not support this growth without additional automation technology**
- **The goal is to create more flexibility and strategic planning related to enable capacity growth for surface operations**



NGATS ATM- Airportal Project Problem Statement (3)

- **The JPDO calls for improvements in airport operations**
 - **Reduce runway occupancy time**
 - **Improve wake vortex sensing and prediction**
 - **Increase use of automated approach, landing, and departure systems**
 - **Reduce current separation standards**
 - **Enable 4-D trajectory-based operations**
 - **Expand use of regional airports**
 - **Meet environmental performance requirements**



NGATS-ATM Airportal Project 4D Trajectory Operations

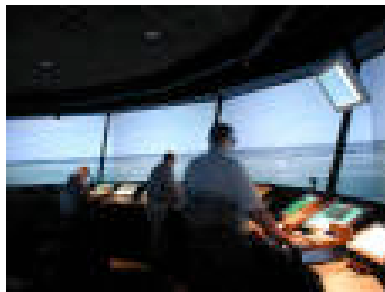


- **JPDO calls for 4-D trajectories block-to-block**
- **Capacity improvement**
- **Increased throughput**
- **Reduced taxi delays**
- **Reduced workload**
- **Reduced runway crossings**
- **Improved Aircraft separation**



NGATS-ATM Airportal Project Optimization Research

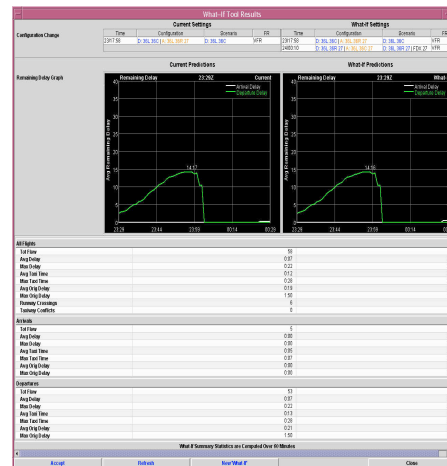
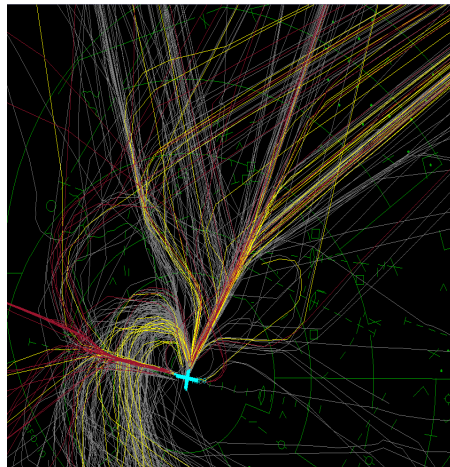
- **Optimization Research**
 - Multiple competitive users competing for scarce resources
 - Human operators require support for complex decision-making
 - Optimization must be robust and consider equity issues





NGATS-ATM Airportal Project

Wake Vortex and Surface Management

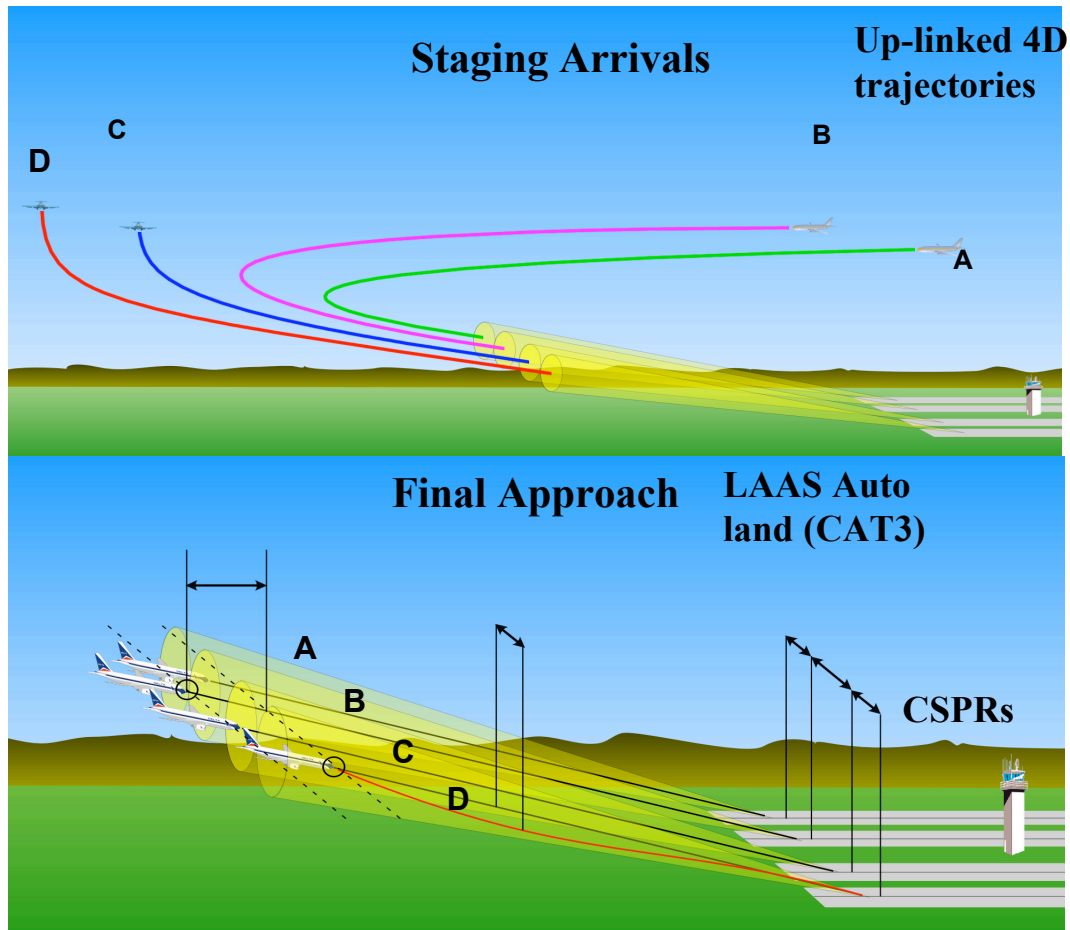


- Integration of these data required for capacity and efficiency
- Wake data will inform surface automation of expected arrivals/departures
- Surface data will inform wake technologies of arrival and departure acceptance rates and airport conditions



NGATS ATM-Airportal Project

Closely-Spaced Parallel Runway and Single Runway Operations



- **Research to enable spacing reductions for closely-spaced runway operations**
 - Wake prediction
 - Human factors
- **Research to enable reduction in longitudinal separation for runways**
 - Wake prediction
 - Human factors



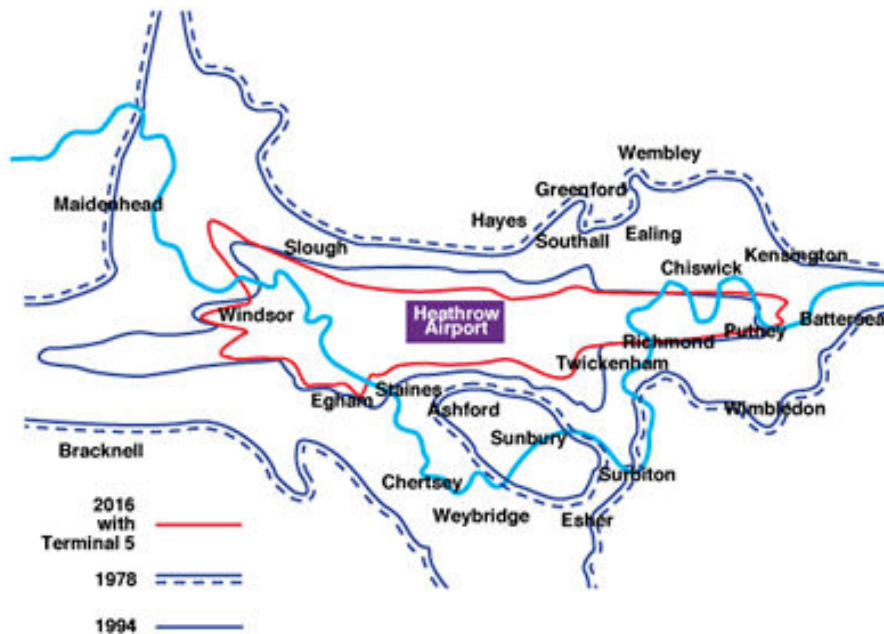
NGATS-ATM Airportal Project Surface Separation Assurance



- **Runway incursion**
- **Taxi conflicts**
- **Joint work with Integrated Intelligent Flight Deck Project (IIFD) in the Safety Program**



NGATS-ATM Airportal Project Environmental Constraints

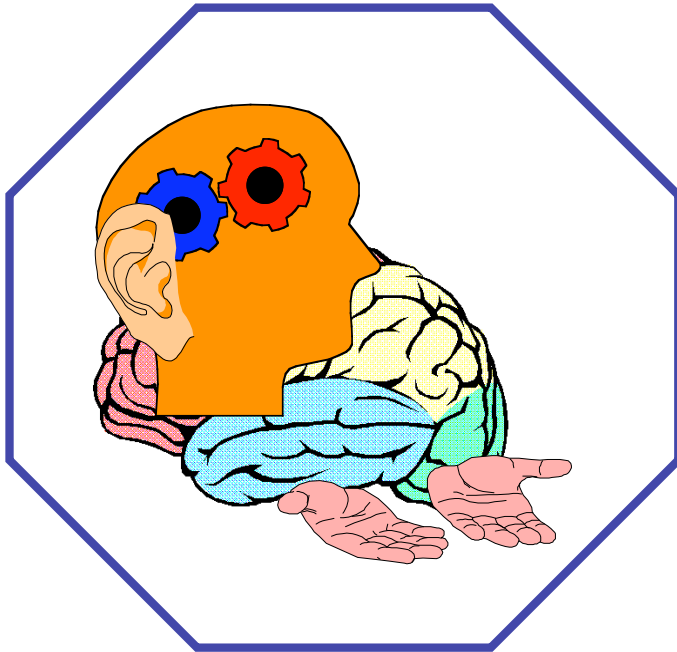


- Environmental required performance (air and noise) must be addressed
 - Capacity improvement solutions must be compatible with these constraints
- Continued development in environmental modeling is required



NGATS-ATM Airportal Project

Human Factors



- **Human-machine allocation**
 - **Intervention requirements**
- **Roles and responsibilities**
- **Interface design**
- **Non-normal situations and graceful degradation**



NGATS ATM- Airportal Project Expected Benefits

- **Enable safe and environmentally compatible Super Density Operations**
 - Reduce longitudinal and lateral spacing for aircraft for converging and closely spaced parallel runways
 - Reduce runway occupancy times
 - Reduce taxi times
 - Balance arrivals and departures
 - Enable dynamic airportal operations
 - Enhance airportal and terminal operations predictability



NGATS ATM- Airportal Project Partnerships

- **Three types of partnerships opportunities**
 - **Industry**
 - **Other Government Agencies and NASA Aeronautics Programs**
 - **FAA**
 - **Volpe**
 - **DOT**
 - **DOD**
 - **NASA's Safety Program**
 - **NASA Fundamental Aeronautics Program**
 - **NASA Research Announcements (NRA) with Universities and Industry**
 - **Directed at fundamental research areas**